Stand up to Action: The Postural Effect of Moral Dilemma Decision-Making and the Moderating Role of Dual Processes

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ABSTRACT

Previous studies have demonstrated the possibility that when people are in standing than sitting postures, they have a stronger cognitive control propensity, making them inclined to agree more to sacrificing one innocent and saving more people. Furthermore, this postural effect can be moderated by dual processes. In three studies, participants read dilemma scenarios followed by a proposed behavior to sacrifice one innocent and save five or more people. The participants in sitting or standing postures were asked whether the described action was morally acceptable (moral judgment) and whether they would perform the described action (moral action). The results demonstrated that participants were more approving of the behavioral proposal in the moral action perspective than in the moral judgment perspective across the three studies. The hypothesized postural effect was found in a field study (Study 1) and replicated in a pre-registered replication study (Study 2) and further supported in an experimental study (Study 3). Compared with those in sitting postures, participants in standing postures expressed higher approval of the behavioral proposal compared to their sitting counterparts. Furthermore, the postural effect was dismissed when participants made moral decisions with a dual task to increase cognitive load, and it was reversed when they made moral decisions after deliberate consideration of the behavioral proposal (Study 3). The present research supports and extends the dual-process morality theory by demonstrating that body posture can affect moral decision-making; it also offers novel evidence revealing the moderating role of dual process on embodiment effects. It enriches our knowledge that morality is evolutionarily embodied in postures and that the dual process can moderate embodiment effects.

Keywords: body posture; moral dilemma; dual process; embodiment; decision-making

Introduction

Standing is an important evolutionary breakthrough for humankind, and it empowers people to walk upright. Bipedalism freed human hands for tool invention and use, and for hunting and warfare, which further led to the high levels of intelligence displayed by humans today (Buss, 2016). This breakthrough enlarged the range of people's social activities and helped humans evolve for social interaction. For example, the power pose can elevate testosterone, decrease cortisol, and increase feelings of power and tolerance for risk (Carney, Cuddy, & Yap, 2010). In this stance, athletes express triumph with their torso out and chest expanded when receiving a medal (Matsumoto & Hwang, 2012), and men who request aid with an expansive posture receive less help (Tracy, Steckler, Randles, & Mercadante, 2018). Posture matters in our social lives, but its relationship with behavior and psychology has been neglected in the research. For a long time, we thought we could behave independently of our postures. However, we now must admit that postures support the mind at all times.

Among postures, the more fundamental positions of standing and sitting are rarely noticed, especially in social interactions. When people make a choice—and, in particular, a moral choice—they are usually either sitting or standing. Recent studies have demonstrated a few psychological effects of these postures (Bluedorn, Turban, & Love, 1999; Burns, Forde, & Dockrell, 2017; Knight & Baer, 2014; Mansoubi et al., 2015; Roerdink, Hlavackova, & Vuillerme, 2011; Rosenbaum, Mama, & Algom, 2017; Thorp et al., 2016). For example, standing up compared to sitting down has been found to decrease the Stroop effect, which is a commonly used indicator of cognitive control. Higher levels of cognitive control are associated with a smaller Stroop effect; that is, standing enhances cognitive control (Rosenbaum et al.,

2017). Compared to sitting, standing can burn more energy and decrease the risk of obesity and cardiovascular disease (Mansoubi et al., 2015; Thorp et al., 2016), and it consumes more attention resources compared to sitting (Roerdink et al., 2011). In addition, behavioral research has demonstrated that meetings in which individuals were standing were 34% shorter than when individuals were sitting. However, group decision performance is comparable regardless of whether individuals are standing or sitting (Bluedorn et al., 1999). Overall, these findings demonstrate that individuals who are standing have a greater cognitive control propensity than those who are sitting. Evolutionarily, standing and walking upright also provide humans more opportunities to reach more resources and better control our lives.

Cognitive control matters in moral life as demonstrated by the dual-process morality theory (Greene, 2007, 2013; Haidt, 2007, 2013). Cognitive and emotional processes are associated with, respectively, approval and disapproval of a proposal that harms others but maximizes positive overall consequences. This kind of behavioral proposal is in line with utilitarianism, which requests the greatest happiness for the greatest number of people (Bentham, 1996), thus, it is called a utilitarian proposal. More controlled cognitive deliberation results in higher levels of approval of the utilitarian proposal (Amit & Greene, 2012; Greene, 2009; Greene, Morelli, Lowenberg, Nystrom, & Cohen, 2008; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001). Given that the standing individuals have a greater propensity for cognitive control than those who are sitting, we predict that individuals who are standing will be more approving of the utilitarian proposal, on average, compared to their sitting counterparts (*Hypothesis 1*).

Nevertheless, it is marvelous that the highly abstract moral propensity is directly rooted in body postures. This kind of postural effect may be inconclusive according to the underlying cognitive process mindsets. When cognitive resources are partly occupied, participants may intuitively make decisions without considering internal cues from their body posture. As a result, the embodiment effect would be eliminated. This speculation is supported by the embodied metaphor studies that demonstrate that embodiment effects are dismissed with increasing cognitive load (Skulmowski & Rey, 2017; Zestcott, Stone, & Landau, 2017). Take the weight-importance metaphor as an example. In one study, participants rated an unrelated topic as more important when holding a moderately heavy clipboard compared to a light one. However, when participants directed some attention to the clipboard's weight and rated the importance of the unrelated topics, this embodiment effect was eliminated (Zestcott et al., 2017). Similarly, exerting physical effort by wearing a backpack led participants to provide higher judgments of learning easy nouns. However, this embodiment effect disappeared when the participants had a high cognitive load and learned more difficult nouns (Skulmowski & Rey, 2017). Findings from these two studies imply that the embodiment effect is eliminated as high cognitive load results in cognitive processes not using bodily cues as the basis for decision-making. Therefore, we expect that the postural effect on moral dilemma decision-making will be eliminated by an additional cognitive load, such as a dual task (*Hypothesis 2*).

In contrast, what if cognitive resource demands are compensated by deliberate thinking? When deliberately considering a moral proposal, decision-makers have full access to all the resources they can utilize, including internal cues from body posture. Thus, we expect that the

postural effect will be recovered such that standing increases approval of the utilitarian proposal to a larger extent than sitting due to stronger cognitive control (*Hypothesis 3a*).

However, the opposite may also be a possibility. First, according to the dual-process morality theory, deliberating individuals will be more utilitarian than members of a non-deliberating control group (Greene et al., 2008); that is, they will be more approving of the utilitarian proposal. Second, as implied by Roerdink et al. (2011), more attention resources are required for standing than for sitting, which means that individuals who are standing must invest some cognitive resources to ensure posture control and, thus, generally have fewer cognitive resources available than do sitting individuals. It can be reasoned from the dual-process morality theory that individuals who are standing will be less utilitarian than those who are sitting. In the present study, we expect that standing individuals will be less approving of the utilitarian proposal than will those who are sitting. In this case, the postural effect on moral dilemma decision-making will be reversed (*Hypothesis 3b*).

To test our hypotheses, we conducted three studies. Study 1 aimed to uncover the postural effect (*Hypothesis 1*) in a natural setting; participants completed a moral decision-making task when either standing or sitting on a football field. Study 2 was a pre-registered study conducted to replicate the postural effect under the experimental setting. Study 3 further replicated the postural effect and tested whether or not dual processes moderate it. Thus, Study 3 was designed with three between-subjects conditions: the control condition, aimed to replicate the postural effect; the intuitive condition, aimed to test whether the postural effect would be dismissed with a dual-cognitive load task; and the rational condition, used to check whether deliberate consideration manipulation would recover or reverse the postural effect. To

summarize, an interaction between posture (standing/sitting) and dual process (control/intuitive/rational) is predicted in Study 3.

Study 1

Method

Participants

Participants in the field study were 63 university students (33 females, aged 18–29, M_{age} = 20.54, SD_{age} = 1.70). They were informed about the study without compromising the research question or the validity of data collection. Participants provided written consent before the study and were compensated with a gift. The study was approved by the Institutional Review Board for Human Participants of Tsinghua University.

As no comparable studies exist as models for the research design, the common sampling strategy of 30 participants per condition was applied, and we aimed to balance participant gender between conditions (see Table 1). All the measures and manipulations are reported here, and no participants were excluded from the analysis. At debrief, no participants reported that their body posture might influence their decisions.

(Table 1 about here)

Design

A 2 (perspective: moral judgment/moral action; within-subjects) × 2 (posture: standing/sitting; between-subjects) mixed analysis of variance (ANOVA) design was used. Participants were randomly distributed across groups and maintained either a natural sitting or standing posture while reading the moral dilemmas and answering the questions.

For the moral decision questions, we used both moral judgment and moral action questions. Previous studies, including our own work, have suggested that individuals are more approving of the utilitarian proposal when the question is framed around the implementation of an action (i.e., a moral action question) than when it is framed around the moral acceptance of an action (i.e., a moral judgment question; Gawronski, Armstrong, Conway, Friesdorf, & Hutter, 2017; Liu & Liao, under review; Pletti, Lotto, Buodo, & Sarlo, 2017). Therefore, we provided two questions from two different perspectives relating to each dilemma. A harmful proposal that maximized positive consequences was included at the end of each dilemma, such as "push the stranger and save the five workers." Participants then answered the moral decision questions in the following order: (1) moral judgment ("Is it morally acceptable to perform the described action?") and (2) moral action ("Would you perform the described action?"). Both questions used a 9-point scale (1 = completely disapproving; 9 = completely approving) to measure extent of approval, with higher scores indicating a higher utilitarian response. The former question focused on moral acceptance while the latter focused on the implementation of moral action. These represent the important knowledge-based and action-based elements of moral decision-making.

A double-blind design was applied. The experimenters were told that the dilemmas were unrelated filler materials included to increase the survey's length, and that we were interested in the name–letter effect (Kitayama & Rarasawa, 1997) related to adopting sitting and standing postures. Participants were told that they were to complete a letter preference evaluation task. Therefore, neither the experimenters nor the participants knew the real purpose of the study, and none reported guessing the true nature of the study when asked afterward.

Materials

The moral dilemma scenarios were chosen from those used by Koenigs et al. (2007), based on having significant moral relevance to the study population (see Part 1 of the supplementary online materials). The scenarios were of similar levels of emotional arousal and word length. The three dilemma scenarios used were "Ecologists," "Footbridge," and "Vitamins" (see Part 2 of the supplementary online materials).

Procedure

The study was conducted on a football field. Passersby were randomly invited to participate. To reduce the effects of potential energy expenditure, the invited participants were restricted to those who had just walked onto the playing field, and those who were currently taking part in, or had just finished, exercise were excluded. Thus, the participants' energy had not been very recently exhausted by physical activity. This sampling strategy was adopted to ensure that participants had sufficient cognitive resources to complete the moral decision task.

Participants were asked to complete a letter preference task while either sitting naturally on a chair or standing. They were all observed within the same zone of the playing field and facing the same direction. The questionnaire was placed on a clipboard, and a pencil was provided. The participants were all right-handed; all used their left hand to hold the clipboard and their right hand for writing. They first completed the letter preference evaluation task and were told that:

present research aims to discover how people evaluate the 26 letters of the alphabet. The responses will only be used for scientific research and teaching courses, and

without any identifying personal information. Thus, please follow your current state and report your intuitive preference.

After finishing the letter preference evaluation task, participants were provided instructions for the moral dilemma test:

Sometimes during our lifetime, we have to make tough decisions. We are conducting a pre-test to filter materials for use in other decision studies. Here, three scenarios that we might face will be presented. Please put yourself in each situation and answer the questions that follow each scenario.

Participants were thanked and debriefed upon completion. In the debrief phase, the participants were asked "whether your decisions were influenced by any contextual factors, such as the light, the temperature, your posture, and so on?" No participants reported any influence from their body posture.

Results

The demographic distribution and average moral ratings are shown in Table 1. We conducted a 2 × 2 ANOVA with moral perspective (moral judgment/moral action) as the within-subjects variable and posture (sitting/standing) as the between-subjects variable. The results revealed a main effect of moral perspective, $F(1, 61) = 35.14$, $p < .001$, $\eta_p^2 = 0.37$, and moral action ratings were significantly higher than were moral judgment ratings. A between-subjects effect of posture was also identified, $F(1, 61) = 4.16$, $p = .046$, $\eta_p^2 = 0.06$, and moral ratings when standing were significantly higher than when sitting. The interaction effect was not significant, $F(1, 61) = 0.33$, $p = .567$, $\eta_p^2 = 0.01$. These results confirm the findings of previous research on the moral question framing effect that suggest that moral action frames

more utilitarian inclinations than does moral judgment (Gawronski et al., 2017; Liu & Liao, under review). The findings also indicate that standing activates more utilitarian inclinations than does sitting, thus supporting *Hypothesis 1*.

Study 2a

As a response to the replication crisis of psychological studies (Open Science Collaboration, 2015), we pre-registered this replicating study to test whether or not the postural effect was robust and to explore the possible boundary conditions. The pre-registration can be retrieved from osf.io/b4dg8.

Method

Participants

We used G*Power to conduct a power analysis and compute the required sample size. In Study 1, we achieved a power of 0.73 given $\alpha = .05$, an effect size $f = .26$, and a sample size of 63. Our goal was to obtain a power of .80 to detect a medium effect size, $f = .26$ (based on Study 1) at the standard .05 alpha error probability. We computed the required sample size with effect size $f = .26$, $\alpha = .05$, power = .80; the result indicated that we needed to recruit 74 participants. In case some participants could not pass the answer-check items, we recruited 80 participants (aged 17–23, M_{age} = 19.74, SD_{age} = 1.20), half of whom were female. The participants were compensated 10 yuan after completing the experiment. The study was approved by the Institutional Review Board for Human Participants of Tsinghua University. The data were analyzed upon study completion, and all the measures and manipulations are reported here.

Design and Materials

The analysis utilized a mixed design with perspective (two levels: moral judgment/moral action) as the within-subjects condition and posture (two levels: standing/sitting) as the between-subjects condition. The variables were manipulated as in Study 1. Participants were randomly assigned to either the sitting or standing condition. In the sitting condition, participants completed the task in a regular seated posture. In the standing condition, they took a regular standing posture with the computer screen adjusted to their preferred height using the standing desk. The moral dilemma decision task was preprogrammed with Inquisit 3.0 to record the answers provided by the participants.

The moral dilemma scenarios were also chosen from those used by Koenigs et al. (2007). The scenarios were of similar emotional arousal level and word length. Five dilemmas were used: "Ecologists," "Footbridge," "Vitamins," "Crying Baby," and "Sacrifice." An answer-check scenario (see Part 2 of the supplementary online materials) was adopted from Gawronski et al. (2017) in which participants were instructed to choose "completely approving." By default, we excluded from the analyses all participants who did not follow these instructions.

Procedure

To mask the research objective, we made up a cover story. The experimenter and the participants were both told that the experiment was a workstation-experience experiment and that the moral dilemma decision-making task was used to simulate a daily office work task. The participants were ushered into a separate room after providing formal consent. They were left alone to conduct the moral dilemma decision-making task first, and then they provided some ratings of the workstation. After completing all tasks, they were thanked and debriefed.

Results

After filtering out the participants who did not follow the manipulation check items, we conducted a 2 × 2 ANOVA with moral perspective (moral judgment/moral action) as the within-subjects variable and posture (sitting/standing) as the between-subjects variable. The results revealed a main effect of moral perspective, $F(1, 69) = 6.93$, $p = .010$, $\eta_p^2 = 0.09$, and moral action ratings were significantly higher than moral judgment ratings. The between-subjects effect of posture was not identified, $F(1, 69) = 0.16$, $p = .690$, $\eta_p^2 = 0.00$. The interaction effect was not significant, $F(1, 69) = 2.55$, $p = .115$, $\eta_p^2 = 0.04$. These results support the findings of previous research on the moral question framing effect that show that moral action frames stronger utilitarian inclinations than does moral judgment (Gawronski et al., 2017; Liu & Liao, under review). However, the postural effect was not found.

We carefully backtracked the experimental procedure and found two important points. First, five participants reported in the debrief session that the standing desk was a little rickety or wobbly. We also found after the experiment that the standing desk was unstable. Second, we speculated that the cover story might lead the participants to adjust their postures so that they could better experience the standing desk. These two additional factors could lead the participants to pay attention to their postures, dismissing the postural effect based on recent relevant evidence (Noah, Schul, & Mayo, 2018; Zestcott et al., 2017). For example, in Noah et al. (2018), the participants rated cartoons as funnier when they held the pen with their teeth than with their lips. However, this facial-feedback effect disappeared when a camera was present to record their reactions. This demonstrates that the embodiment effect could be dismissed if the participants pay attention to the embodied variable. We think that the instability

of the standing desk and the content of the cover story could potentially have drawn the participants' attention to their posture resulting in our dismissal of the postural effect. Thus, we changed the experimental settings and conducted Study 2b. First, we used a new standing desk to replace the former wobbly one. Second, we adjusted the cover story. The experimenter was told that the participants might pay too much attention to the workstation, which would confound the workstation-experience ratings. Therefore, the participants were only told that the study is a common psychological experiment. The rest of the procedure was the same as that used in Study 2a.

Study 2b

Method

Participants

We recruited 80 participants aged 18–23 (M_{age} = 19.59, SD_{age} = 0.96), half of whom were female. The participants were compensated 10 yuan after completing the experiment. The study was approved by the Institutional Review Board for Human Participants of Tsinghua University. The data were analyzed upon study completion, and all the measures and manipulations are reported here.

Design, Materials, and Procedure

The design, materials, and procedure were almost identical to those of Study 2a, except that the standing desk was replaced with a stable one and the cover story was altered as described above.

Results

After filtering the participants who did not follow the instructions in the manipulation check, we conducted a 2 × 2 ANOVA with moral perspective (moral judgment/moral action) as the within-subjects variable and posture (sitting/standing) as the between-subjects variable. The results revealed a main effect of moral perspective, $F(1, 68) = 16.95$, $p < .001$, $\eta_p^2 = 0.20$, and moral action ratings were significantly higher than moral judgment ratings. The between-subjects effect of posture was identified, $F(1, 68) = 5.70$, $p = .020$, $\eta_p^2 = 0.08$, and the participants in the standing condition gave significantly higher ratings than those in the sitting condition. The interaction effect was not significant, $F(1, 68) = 0.28$, $p = .598$, $\eta_p^2 = 0.00$. These results support the findings of previous research on the moral question framing effect (Gawronski et al., 2017; Liu & Liao, under review), and the postural effect was again found.

Overall, Study 2 replicated the postural effect after we altered the cover story and replaced the old wobbly standing desk with a new stable one. It demonstrated that the postural effect might be potentially moderated by the dual process, which was assessed in Study 3.

Study 3

Method

Participants

We recruited 220 university students, and 180 of them (93 females, aged 18–23, M_{age} = 20.14, SD_{age} = 1.12) passed the manipulation check scenario (described below). The participants were informed about the study without compromising the research question or the validity of the data collection. Participants provided written consent before the study and were compensated with a gift or course credit according to their preference. The study was approved

by the Institutional Review Board for Human Participants Tsinghua University. Data were analyzed upon study completion, and all the measures and manipulations are reported here.

Design and Materials

To test the hypotheses, we conducted a 3 (dual process: control/intuitive/rational; between-subjects) × 2 (posture: sitting/standing; between-subjects) × 2 (perspective: moral judgment/moral action; within-subjects) mixed ANOVA design. The control condition was used to replicate the postural effect. The intuitive condition was designed to test whether dual cognitive load would dismiss the postural effect (*Hypothesis 2*), and the rational condition tested whether deliberate consideration would recover or reverse the postural effect (*Hypothesis 3a/3b*). Altogether, the dual process (control/intuitive/rational) might moderate the postural effect, thus an interaction effect between dual process and posture might be detected. The moral dilemma materials were the same as those used in Study 2.

Procedure

Participants completed the task on a computer. The computer screen was elevated in the standing condition using a standing desk and placed on the desk as usual in the sitting condition. After providing informed consent, the participants were randomly assigned to one of the between-subjects conditions. Participants finished the letter preference evaluation task after receiving the same instructions used in Study 1. Then, the moral dilemma scenarios were presented in random order using Inquisit 3.0, and the participants read each dilemma and answered the moral decision questions.

The procedure for the control condition was the same as Study 1. The only difference between the intuitive condition and the control condition was that participants in the former

needed to remember a meaningless five-letter string (e.g., “bukps”) that was presented with each scenario before answering the moral decision-making questions. As previous studies have demonstrated that working memory is limited to about seven chunks (Miller, 1956), we used five characters in the dual task to avoid completely overloading their working memory. Furthermore, to avoid any anchoring effects following the moral decisions, we did not use Arabic numerals in the dual task; this is because, in the moral decision task, participants might choose the same Arabic number that appeared in the dual task. To avoid this possibility, we used only letter strings in the dual task. The only difference between the rational condition and the control condition was that participants in the former were required to answer a deliberate question (i.e., “Regardless of whether you agree or disagree with the above proposal, what is your reason for this?”) without any time limit before completing the moral decision questions. Participants freely answered the question and then made the moral decisions.

Participants were thanked and debriefed upon completion in the same way as Study 1. No participant reported any influence of posture on their decision-making.

Results

First, we conducted a 2 × 2 ANOVA, as in Study 1, with the data for the control condition. The results showed a main effect of moral perspective, $F(1, 62) = 57.40$, $p < .001$, $\eta_p^2 = 0.48$. Moral action ratings were significantly higher than moral judgment ratings. There was also a between-subjects effect of posture, $F(1, 62) = 5.32$, $p = .024$, $\eta_p^2 = 0.08$, in which the moral rating when standing was significantly higher than when sitting. The interaction effect was not significant, $F(1, 62) = 0.02$, $p = .894$, $\eta_p^2 = 0.00$. These findings replicated those

from Study 1 and further supported *Hypothesis 1*, demonstrating that the postural effect of moral decisions is robust in both field and laboratory research.

Next, we conducted a 3 (dual process: control/intuitive/rational; between-subjects) × 2 (posture: sitting/standing; between-subjects) × 2 (perspective: moral judgment/moral action; within-subjects) mixed ANOVA analysis to further test the hypotheses. The results revealed a main effect for moral perspective, $F(1, 174) = 137.02$, $p < .001$, $\eta_p^2 = 0.44$, and moral action ratings were significantly higher than moral judgment ratings, confirming the moral question framing effects (Gawronski et al., 2017; Liu & Liao, under review).

The between-subjects effect for dual process was significant, $F(2, 174) = 31.25$, $p < .001$, $\eta_p^2 = 0.26$, and multi-comparisons with the least significant difference (*LSD*) test demonstrated that moral ratings in the intuitive condition were significantly higher than in the control condition (95% CI of the difference [0.36, 1.41]), and that moral ratings in the rational condition were significantly higher than in the control condition (95% CI of the difference [1.61, 2.68]) and in the intuitive condition (95% CI of the difference [0.71, 1.80]). These results support the intuitive utilitarianism theory (Bago & De Neys, 2019; Bialek & De Neys, 2017), demonstrating the possibility that individuals might intuitively be more approving of a harmful proposal that could maximize benefits. The results also partly support the dual-process morality theory, suggesting that deliberate thinking increases approval of utilitarian proposals (Greene et al., 2008).

The results did not demonstrate a between-subjects effect of posture, $F(1, 174) = 0.07$, $p = .788$, $\eta_p^2 = 0.00$, but the interaction between posture and dual process was significant, $F(2, 174) = 3.98$, $p = .020$, $\eta_p^2 = 0.04$. Specifically, as shown in Fig. 1, the simple effects of the dual

process for sitting, $F(2, 174) = 27.76$, $p < .001$, $\eta_p^2 = 0.24$, and standing, $F(2, 174) = 6.77$, $p = .001$, $\eta_p^2 = 0.07$, were both significant. Furthermore, the simple effect of posture was marginally significant in the control condition, $F(1, 174) = 3.71$, $p = .056$, $\eta_p^2 = 0.03$; not significant in the intuitive condition, $F(1, 174) = 0.04$, $p = .837$, $\eta_p^2 = 0.00$; and reversed in the rational condition, $F(1, 174) = 4.22$, $p = .041$, $\eta_p^2 = 0.02$. No other interactions were found.

(Fig. 1 about here)

Altogether, the results replicated the moral question framing effect (Gawronski et al., 2017; Liu & Liao, under review) and the hypothesized postural effect of moral dilemma decision-making (*Hypothesis 1*). The results also support *Hypothesis 2*, that the postural effect is dismissed when cognitive resources are burdened and participants have to intuitively make moral decisions. Further, the postural effect was reversed after deliberate thinking, supporting *Hypothesis 3b* and rejecting *Hypothesis 3a*.

General Discussion

The findings demonstrate that standing compared to sitting increases people's approval inclinations for the harmful utilitarian proposal when the underlying cognitive process is not artificially manipulated. The pre-registered replication demonstrated that the postural effect can be replicated, but the effect is very sensitive to the contextual factors. When the experimental settings or the environmental variables draw the attention of participants to their postures, the postural effect is dismissed. Furthermore, the postural effect was moderated by the dual process; while it was not apparent under the intuitive process, it was reversed under the rational process. These findings indicate that body posture can influence moral decision-

making and that the wide range of social-psychological effects found when individuals are sitting should be revalidated for participants who are standing. Furthermore, replication failures for many embodiment effects may be due to the underlying cognitive processes or some contextual covariates being uncontrolled.

The studies discussed here uncovered the moderating role of dual processes on postural effect in moral decision-making. Specifically, the results suggest three findings related to the postural effect. First, posture control as a background task induces co-varying cognitive inclination which influences the immediate task when the cognitive process is not artificially manipulated. Second, the posture cue cannot access cognitive processes and influence the immediate task when a cognitive process is occupied by completing dual immediate tasks. Finally, posture control impairs cognitive resources and influences the immediate task when cognitive inclination is intensified by deliberate thinking.

The findings can be understood and explained in an evolutionary perspective. Humans' thoughts are restricted by the body and its surroundings. Standing makes humans reach out to their wild surroundings and care more about behavioral consequences in the competition for survival. As a result, standing participants cared more about whether the consequences of their decision would be beneficial compared to their seated counterparts. As humans evolved to stand, posture control became a background task; whatever we do, we are always in some posture. Although evolution has enabled us to multitask so that we can survive, conducting these multiple immediate tasks expends our cognitive resources so that cognitive processes cannot reach the bodily background cues, thus dismissing the postural effects. However, cognitive resources are compensated with deliberate thinking, and even more so in sitting than

in standing, so that the postural effect is reversed. Evolutionarily, these processes make sense for better adapting to the world and empowering humans to survive.

Contributions and Limitations

The present research contributes to the embodied cognition literature by identifying a new postural effect on moral decision-making and the boundary condition of dual process. It expands dual-process morality theory to explain embodied moral decision-making and provides novel evidence for the psychological differences between sitting and standing postures (Bluedorn et al., 1999; Burns et al., 2017; Knight & Baer, 2014; Mansoubi et al., 2015; Roerdink et al., 2011; Rosenbaum et al., 2017; Thorp et al., 2016). Three main theoretical contributions arising from this work should be considered.

First, the findings from the present study have some key implications for the replication crisis and embodiment effects. Many failures to replicate embodiment effects may be due to underlying cognitive processes or contextual covariates being uncontrolled. As discussed above, if participants hurriedly complete an experimental task, they mainly react using their intuition. Consequently, they do not use bodily and environmental cues to support their decisions, and embodiment effects disappear (Skulmowski & Rey, 2017; Zestcott et al., 2017). Besides, if some of the experimental settings or the contextual covariates attract the participants' attention on the embodied variables, the target embodiment effect might be dismissed, as observed in our replication in Study 2 and in the studies conducted by Noah et al. (2018). On the other hand, as shown in the rational condition of Study 3, if some participants silently reverse postural effects using deliberate thinking while others retain the original postural effects, the postural effects of moral decisions will balance out overall. Such a possibility could

account for many failed replications, such as with the power pose effect (Carney et al., 2010; Cuddy, Schultz, & Fosse, 2018). In a word, many replication failures of psychological effects should be treated cautiously because other covariates could be interfering with the target effect.

Second, experimental findings gathered from participants in a seated posture may differ from those obtained when participants are standing (Rosenbaum et al., 2017). As standing increases cognitive control propensity and the readiness-for-action state, it leads to different behavioral effects. The present study demonstrated that the cognitive control inclination enhancement of standing could influence downstream moral decisions, rather than only influencing attention distribution. Therefore, the postural effect might exist across diverse fields. Further consideration of the different effects resulting from standing and sitting will enrich and enhance the associated psychological theories.

Third, previous research has demonstrated an intuitive utilitarian sensitivity in moral dilemma decision-making (Bago & De Neys, 2019; Bialek & De Neys, 2017), and the present research contributes novel support for this theory. As shown in Study 2, the moral ratings in the intuitive condition were significantly higher than in the control condition. This means that, although participants intuitively reacted to the dilemmas, they did not become less utilitarian or more averse to the harmful proposal, as implied by the dual-process morality theory. On the contrary, they became more approving of the harmful proposal. In other words, they intuitively held a more utilitarian moral attitude than did the control group.

Finally, the moral question framing effect was consistently replicated across the three studies whether the cognitive process was artificially manipulated or not. This demonstrates that the moral question framing effect is not affected by cognitive process differences between

the two questions. Liu and Liao (under review) alleged that this is mainly due to motivation and not to emotional processes, which can be explained by the action-based model of cognitive dissonance (Harmon-Jones & Harmon-Jones, 2002; Harmon-Jones, Harmon-Jones, & Levy, 2015; Harmon-Jones, Price, & Harmon-Jones, 2015; Harmon-Jones, Amodio, & Harmon-Jones, 2009). Further, the present research provides evidence that the cognitive processing discrepancy does not impact the moral question framing effect.

Two limitations of the current study and future directions for research should be noted. First, the mechanism of the postural effect could be further explored. In terms of physiology, many biological markers differ between sitting and standing postures, including center-of-pressure regularity (Roerdink et al., 2011) and energy expenditure (Burns et al., 2017). Future studies could explore which physiological changes account for the postural effect on moral decision-making. Another possible mechanism is the language metaphor. There is a Chinese saying, “Rise up to action,” which might link the standing posture to approving the proposed action. Future studies could assess whether the embodied metaphor mechanism exists in the postural effect.

Second, supine posture should also be considered in terms of its psychological effects. Some researchers found that supine posture reduces neural response to anger evocation (Harmon-Jones & Peterson, 2009), reduces the approach motivation, and further decreases rationalization (Harmon-Jones, Price, & Harmon-Jones, 2015) compared to upright posture. Moreover, another study demonstrated that supine posture inhibits cortical activity to a greater extent than does seated posture (Spironelli, Busenello, & Angrilli, 2016). This evidence implies that supine posture is another specific stance that might result in many psychological effects.

Evolutionarily, supine posture is also more primitive in a person's development. Thus, future studies should consider supine posture's effects on morality and other social-psychological factors.

Conclusion

Standing enhances higher levels of cognitive control compared to sitting, and it makes people more approving of utilitarian behavior. This postural effect can be dismissed when individuals are intuitively making moral decisions, and it can be reversed when they are deliberately thinking before making moral decisions. As an evolutionary result, standing motivates us to care more about the beneficial consequences in moral lives than does sitting, and this postural effect depends on the cognitive process mindset. The evidence obtained by the present study also implies that many failures of replications might be due to uncontrolled cognitive processes.

Disclosure of conflict of interest

The authors declare no conflicts of interest.

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References

Amit, E., & Greene, J. D. (2012). You see, the ends don't justify the means: Visual imagery and moral judgment. *Psychological Science, 23*(8), 861–868. https://doi.org/10.1177/0956797611434965

Bago, B., & De Neys, W. (2019). The intuitive greater good: Testing the corrective dual process model of moral cognition. *Journal of Experimental Psychology: General, 148*(10), 1782–1801. https://doi.org/10.1037/xge0000533

Bentham, J. ([1781] 1996). *An introduction to the principles of morals and legislation*. London: Oxford University Press.

Bialek, M., & De Neys, W. (2017). Dual processes and moral conflict: Evidence for deontological reasoners' intuitive utilitarian sensitivity. *Judgment and Decision Making, 12*(2), 148–167. http://www.sjdm.org/journal/17/17224/jdm17224.pdf

Bluedorn, A. C., Turban, D. B., & Love, M. S. (1999). The effects of stand-up and sit-down meeting formats on meeting outcomes. *Journal of Applied Psychology, 84*(2), 277–285. https://doi.org/10.1037/0021-9010.84.2.277

Burns, J., Forde, C., & Dockrell, S. (2017). Energy expenditure of standing compared to sitting while conducting office tasks. *Human Factors, 59*(7), 1078–1087. https://doi.org/10.1177/0018720817719167

Buss, D. M. (2016). *Evolutionary psychology: The new science of the mind* (5th ed.). New York: Routledge.

Carney, D. R., Cuddy, A. J., & Yap, A. J. (2010). Power posing: Brief nonverbal displays affect neuroendocrine levels and risk tolerance. *Psychological Science, 21*(10), 1363–1368. https://doi.org/10.1177/0956797610383437

Cuddy, A. J. C., Schultz, S. J., & Fosse, N. E. (2018). P-curving a more comprehensive body of research on postural feedback reveals clear evidential value for power-posing effects: Reply to Simmons and

Simonsohn (2017). *Psychological Science, 29*(4), 656–666. https://doi.org/10.1177/0956797617746749

Gawronski, B., Armstrong, J., Conway, P., Friesdorf, R., & Hutter, M. (2017). Consequences, norms, and generalized inaction in moral dilemmas: The CNI model of moral decision-making. *Journal of Personality and Social Psychology, 113*(3), 343–376. https://doi.org/10.1037/pspa0000086

Greene, J. D. (2007). Why are VMPFC patients more utilitarian? A dual-process theory of moral judgment explains. *Trends in Cognitive Sciences, 11*(8), 322–323; author reply 323–324. https://doi.org/10.1016/j.tics.2007.06.004

Greene, J. D. (2009). Dual-process morality and the personal/impersonal distinction: A reply to McGuire, Langdon, Coltheart, and Mackenzie. *Journal of Experimental Social Psychology, 45*(3), 581–584. https://doi.org/10.1016/j.jesp.2009.01.003

Greene, J. D. (2013). *Moral tribes: Emotion, reason, and the gap between us and them*. New York: Penguin Press.

Greene, J. D., Morelli, S. A., Lowenberg, K., Nystrom, L. E., & Cohen, J. D. (2008). Cognitive load selectively interferes with utilitarian moral judgment. *Cognition, 107*(3), 1144–1154. https://doi.org/10.1016/j.cognition.2007.11.004

Greene, J. D., Sommerville, R. B., Nystrom, L. E., Darley, J. M., & Cohen, J. D. (2001). An fMRI investigation of emotional engagement in moral judgment. *Science, 293*(5537), 2105–2108. https://doi.org/10.1126/science.1062872

Haidt, J. (2007). The new synthesis in moral psychology. *Science, 316*(5827), 998–1002. https://doi.org/10.1126/science.1137651

Haidt, J. (2013). Moral psychology for the twenty-first century. *Journal of Moral Education, 42*(3), 281–297. https://doi.org/10.1080/03057240.2013.817327

Harmon-Jones, E., Amodio, D. M., & Harmon-Jones, C. (2009). Action-based model of dissonance. *Advances in*

Experimental Social Psychology, 41, 119–166. https://doi.org/10.1016/s0065-2601(08)00403-6

Harmon-Jones, E., & Harmon-Jones, C. (2002). Testing the action-based model of cognitive dissonance: The effect of action orientation on postdecisional attitudes. *Personality and Social Psychology Bulletin, 28*(6), 711–723. https://doi.org/10.1177/0146167202289001

Harmon-Jones, E., Harmon-Jones, C., & Levy, N. (2015). An Action-Based Model of Cognitive-Dissonance Processes. *Current Directions in Psychological Science, 24*(3), 184–189. https://doi.org/10.1177/0963721414566449

Harmon-Jones, E., & Peterson, C. K. (2009). Supine body position reduces neural response to anger evocation. *Psychological Science, 20*(10), 1209–1210. https://doi.org/10.1111/j.1467-9280.2009.02416.x

Harmon-Jones, E., Price, T. F., & Harmon-Jones, C. (2015). Supine body posture decreases rationalizations: Testing the action-based model of dissonance. *Journal of Experimental Social Psychology, 56*, 228–234. https://doi.org/10.1016/j.jesp.2014.10.007

Kitayama, S., & Rarasawa, M. (1997). Implicit self-esteem in Japan: Name letters and birthday numbers. *Personality and Social Psychology Bulletin, 23*(7), 736–742. https://doi.org/10.1177/0146167297237006

Knight, A. P., & Baer, M. (2014). Get up, stand up: The effects of a non-sedentary workspace on information elaboration and group performance. *Social Psychological and Personality Science, 5*(8), 910–917. https://doi.org/10.1177/1948550614538463

Koenigs, M., Young, L., Adolphs, R., Tranel, D., Cushman, F., Hauser, M., & Damasio, A. (2007). Damage to the prefrontal cortex increases utilitarian moral judgements. *Nature, 446*(7138), 908–911. https://doi.org/10.1038/nature05631

Liu, C., & Liao, J. (under review). The motivation process of the moral-question framing effect is explained by the action-based model of cognitive dissonance.

http://www.chinaxiv.org/businessFile/201904/201904.00087v5/201904.00087v5.pdf

Mansoubi, M., Pearson, N., Clemes, S. A., Biddle, S. J., Bodicoat, D. H., Tolfrey, K., . . . Yates, T. (2015). Energy expenditure during common sitting and standing tasks: Examining the 1.5 MET definition of sedentary behaviour. *BMC Public Health, 15*, 516. https://doi.org/10.1186/s12889-015-1851-x

Matsumoto, D., & Hwang, H. S. (2012). Evidence for a nonverbal expression of triumph. *Evolution and Human Behavior, 33*(5), 520–529. https://doi.org/10.1016/j.evolhumbehav.2012.01.005

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *The Psychological Review, 63*, 81–97. https://doi.org/10.1037/0033-295X.101.2.343

Noah, T., Schul, Y., & Mayo, R. (2018). When both the original study and its failed replication are correct: Feeling observed eliminates the facial-feedback effect. *Journal of Personality and Social Psychology, 114*(5), 657–664. https://doi.org/10.1037/pspa0000121

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science, 349*(6251), aac4716. https://doi.org/10.1126/science.aac4716

Pletti, C., Lotto, L., Buodo, G., & Sarlo, M. (2017). It's immoral, but I'd do it! Psychopathy traits affect decision-making in sacrificial dilemmas and in everyday moral situations. *British Journal of Psychology, 108*(2), 351–368. https://doi.org/10.1111/bjop.12205

Roerdink, M., Hlavackova, P., & Vuillerme, N. (2011). Center-of-pressure regularity as a marker for attentional investment in postural control: A comparison between sitting and standing postures. *Human Movement Science, 30*(2), 203–212. https://doi.org/10.1016/j.humov.2010.04.005

Rosenbaum, D., Mama, Y., & Algom, D. (2017). Stand by your Stroop: Standing up enhances selective attention and cognitive control. *Psychological Science, 28*(12), 1864–1867. https://doi.org/10.1177/0956797617721270

Skulmowski, A., & Rey, G. D. (2017). Bodily effort enhances learning and metacognition: Investigating the relation between physical effort and cognition using dual-process models of embodiment. *Advances in Cognitive Psychology, 13*(1), 3–10. https://doi.org/10.5709/acp-0202-9

Spironelli, C., Busenello, J., & Angrilli, A. (2016). Supine posture inhibits cortical activity: Evidence from Delta and Alpha EEG bands. *Neuropsychologia, 89*, 125–131. https://doi.org/10.1016/j.neuropsychologia.2016.06.015

Thorp, A. A., Kingwell, B. A., English, C., Hammond, L., Sethi, P., Owen, N., & Dunstan, D. W. (2016). Alternating sitting and standing increases the workplace energy expenditure of overweight adults. *Journal of Physical Activity and Health, 13*(1), 24–29. https://doi.org/10.1123/jpah.2014-0420

Tracy, J. L., Steckler, C. M., Randles, D., & Mercadante, E. (2018). The financial cost of status signaling: Expansive postural displays are associated with a reduction in the receipt of altruistic donations. *Evolution and Human Behavior, 39*(5), 520–528. https://doi.org/10.1016/j.evolhumbehav.2018.05.001

621 **Tables**

622 Table 1. Demographic distribution of the valid participants and the description of moral ratings

623 ($M \pm SD$)

	Between-subject condition	n_{female}	n_{male}	M_{age}	SD_{age}	moral rating ($M \pm SD$) judgment	action
Study 1	Sitting	18	14	20.81	2.09	2.98±1.47	4.16±1.88
	Standing	15	16	20.26	1.15	3.65±1.87	5.08±1.84
Study 2	Study 2a: sitting	19	19	19.58	1.29	5.04±1.41	5.21±1.30
	Study 2a: standing	17	16	20.03	1.13	4.89±1.57	5.59±1.38
	Study 2b: sitting	19	17	19.58	0.69	4.27±1.15	5.11±1.29
	Study 2b: standing	14	20	19.56	1.13	5.07±1.66	5.72±1.64
Study 3	Control: sitting	16	15	20.17	1.35	2.69±1.41	4.09±1.54
	Control: standing	18	15	20.36	1.39	3.43±1.27	4.78±1.52
	Intuitive: sitting	15	15	19.80	0.92	4.20±1.45	5.15±1.48
	Intuitive: standing	15	15	19.63	0.85	4.00±1.72	5.19±1.74
	Rational: sitting	13	14	20.26	0.94	5.54±2.16	7.06±1.49
	Rational: standing	16	13	20.07	0.80	4.69±2.16	6.28±1.94

624

625 **Figure captions**

626 Fig. 1. The postural effect of moral ratings was moderated by dual process. The error bars
627 represent ± 1 standard error.